ABSTRACT

The present invention provides a single-crystal ZnO thin film having a high ferromagnetic transition temperature. In one aspect of the present invention, the ZnO thin film comprises a ferromagnetic p-type single-crystal zinc oxide including a transition metal element consisting of Mn, and a p-type dopant. In another aspect of the present invention, the thin film comprises a ferromagnetic p-type single-crystal zinc oxide including a transition metal element consisting of Mn, a p-type dopant, and an n-type dopant. The single-crystal zinc oxide material can be applied to quantum computers and high-capacity magnetic-optical recording medium by combining with conventional n-type or p-type transparent electrode ZnO materials or optical fibers, and to powerful information-communication devices or quantum computers as a photoelectric material usable for a wide range from visible light to ultraviolet light.